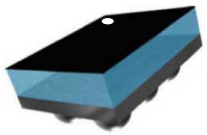
# MLPF-WB-02D3

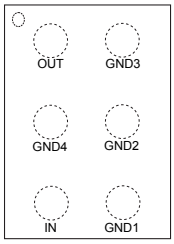
Datasheet

## 2.4 GHz low pass filter matched to STM32WB5x and STM32WB1x in WLCSP and UFBGA packages



Chip scale package on glass 6 bumps

Pin-out top diagram (top view - bumps down)




| Product status link |
| --- |
| MLPF-WB-02D3 |

## Features

- Integrated impedance matching to STM32WB5x and STM32WB1x in WLCSP and UFBGA packages
- 50 Ω nominal impedance on antenna side
- Deep rejection harmonics filter
- Low insertion loss
- Small footprint
- Low profile ≤ 630 µm after reflow
- High RF performances
- RF BOM and area reduction
- ECOPACK2 compliant component

## Applications

- Bluetooth 5
- OpenThread
- Zigbee®
- IEEE 802.15.4
- Optimized for STM32WB5x and STM32WB1x in WLCSP and UFBGA packages

## Description

The MLPF-WB-02D3 integrates an impedance matching network and harmonics filter. The matching impedance network has been tailored to maximize the RF performances of STM32WB5x and STM32WB1x in WLCSP and UFBGA packages. This device uses STMicroelectronics IPD technology on non-conductive glass substrate which optimizes RF performances.

# 1 Characteristics

**Table 1. Absolute ratings ($T_{amb}$ = 25 °C)**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $P_{IN}$ | Input power $RF_{IN}$ | 10 | dBm |
| $V_{ESD}$ | ESD ratings human body model (JESD22-A114-C), all I/O one at a time while others connected to GND | 2000 | V |
| $T_{OP}$ | Maximum operating temperature | -40 to +105 | °C |

**Table 2. Impedances ($T_{amb}$ = 25 °C)**

| Symbol | Parameter | Value | | | Unit |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | |
| $Z_{IN}$ | STM32WBxx single-ended impedance | - | Matched to STM32WB5x and STM32WB1x in WLCSP and UFBGA packages | - | Ω |
| $Z_{OUT}$ | Antenna impedance | - | 50 | - | Ω |

**Table 3. Electrical characteristics and RF performances ($T_{amb}$ = 25 °C)**

| Symbol | Parameter | | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| f | Frequency range | | 2400 | | 2500 | MHz |
| IL | Insertion loss $IS_{21}I$ | | | 1.0 | 1.2 | dB |
| $RL_{IN}$ | Input return loss $IS_{11}I$ | | 15 | 19 | | dB |
| $RL_{OUT}$ | Output return loss $IS_{22}I$ | | 16 | 23 | | dB |
| Att | Harmonic rejection levels $IS_{21}I$ | Attenuation at 2fo (4800 – 5000) MHz | 46 | 47 | | dB |
| | | Attenuation at 3fo (7200 – 7500) MHz | 50 | 54 | | dB |
| | | Attenuation at 4fo (9600 – 10000) MHz | 45 | 61 | | dB |
| | | Attenuation at 5fo (12000 – 12500) MHz | 38 | 45 | | dB |

## 1.1 RF measurement

**Figure 1. Transmission (dB)**

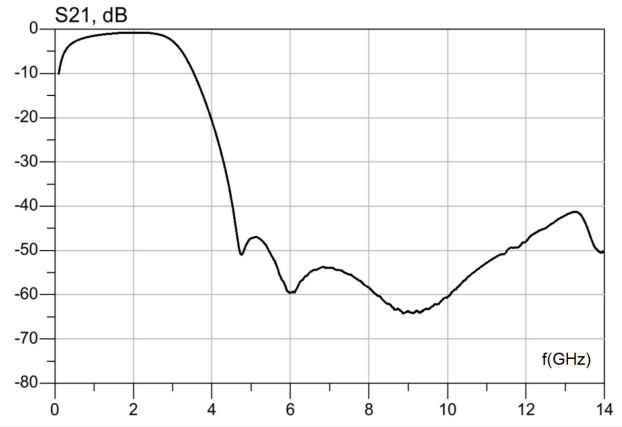



**Figure 2. Insertion loss (dB)**

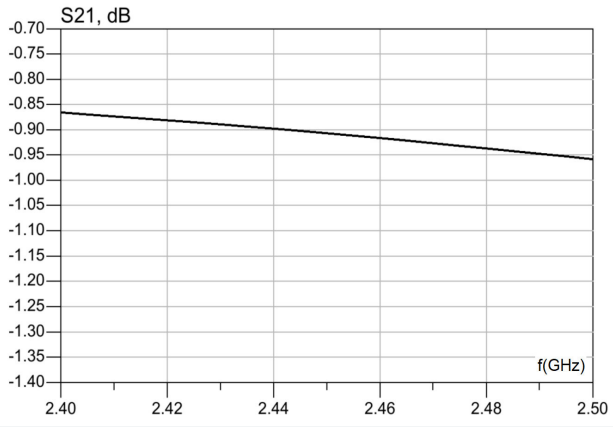



**Figure 3. Input return loss (dB)**

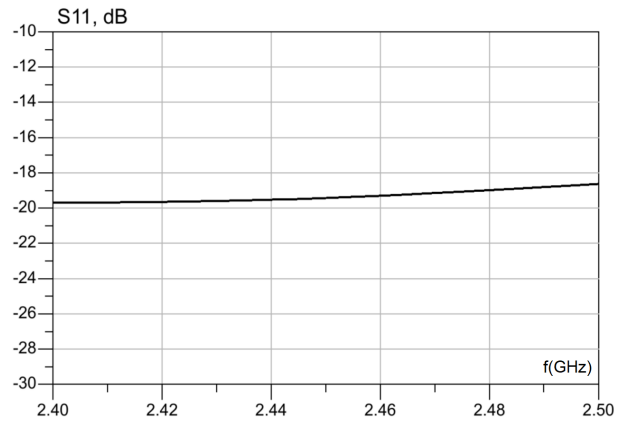



**Figure 4. Output return loss (dB)**

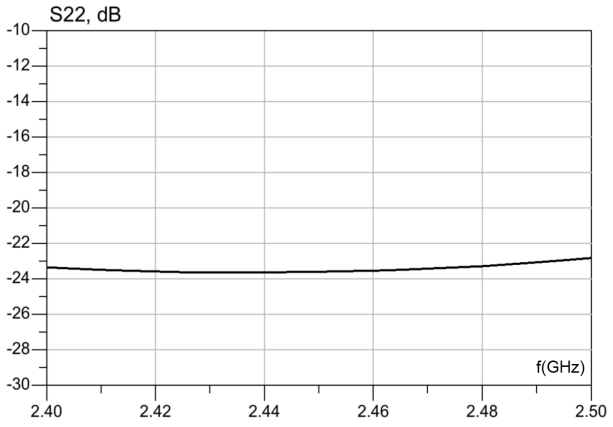



**Figure 5. Attenuation 2f0 (dB)**

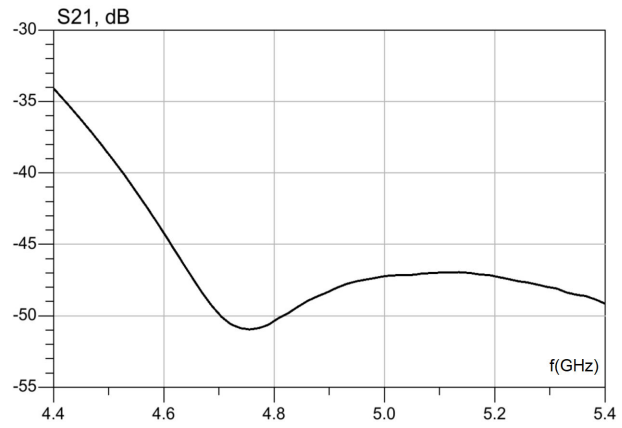



**Figure 6. Attenuation 3f0 (dB)**

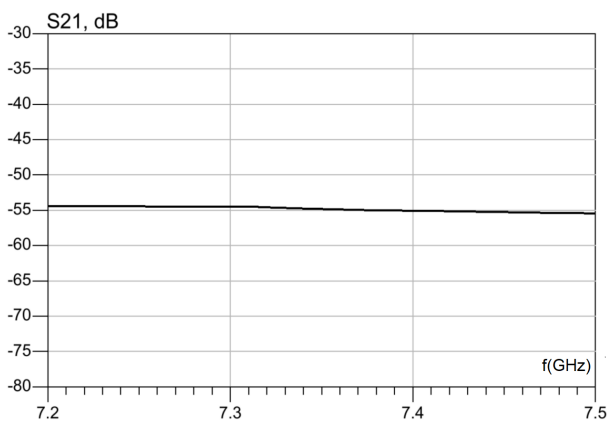


Figure 7. **Attenuation 4f0 (dB)**

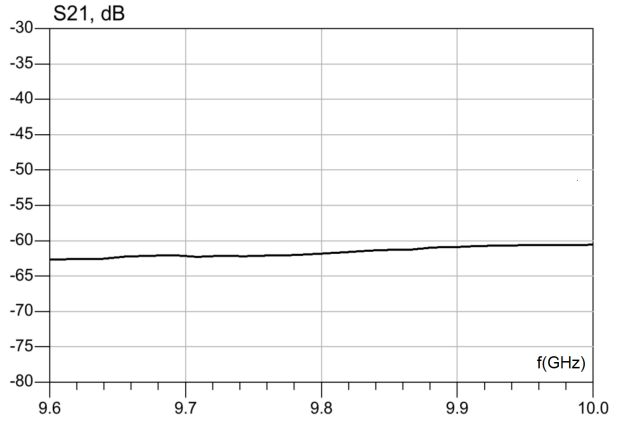
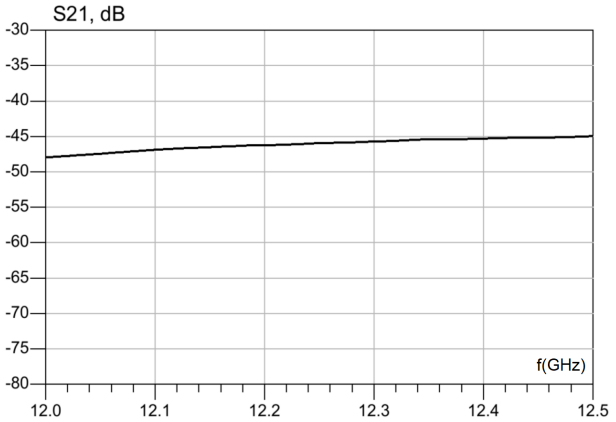



Figure 8. **Attenuation 5f0 (dB)**



# 2 Package information

To meet environmental requirements, ST offers these devices in different grades of ECOPACK packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions, and product status are available at: www.st.com. ECOPACK is an ST trademark.

## 2.1 CSPG package information

**Figure 9. CSPG package outline (bottom view - bumps up)**

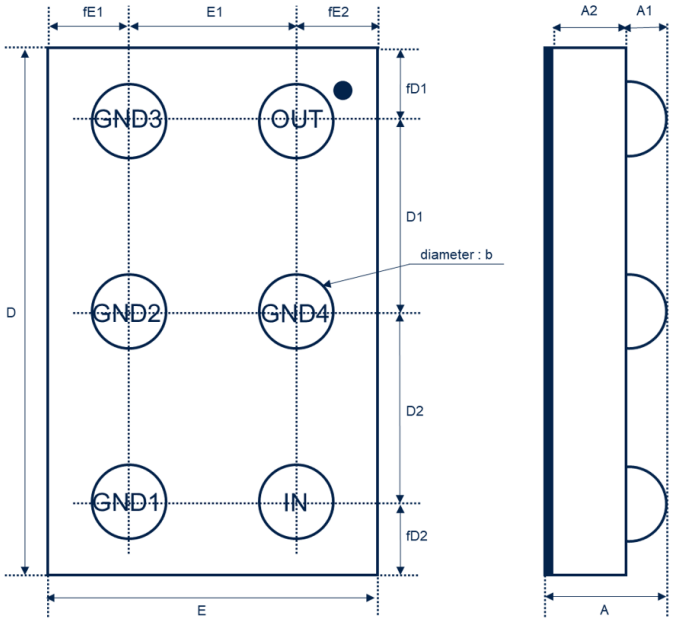



**Table 4. CSPG 6 bumps mechanical data**

| Ref. | Dimensions | | |
|---|---|---|---|
| | Millimeters | | |
| | Min. | Typ. | Max. |
| A | 0.580 | 0.630 | 0.680 |
| A1 | 0.180 | 0.205 | 0.230 |
| A2 | 0.380 | 0.400 | 0.420 |
| b | 0.230 | 0.255 | 0.280 |
| D | 1.550 | 1.600 | 1.650 |
| D1 | | 0.577 | |
| D2 | | 0.577 | |
| E | 0.950 | 1.000 | 1.050 |
| E1 | | 0.500 | |
| fD1 | | 0.223 | |
| fD2 | | 0.223 | |
| fE1 | | 0.250 | |
| fE2 | | 0.250 | |

Figure 10. **Marking**


Figure 11. **Top view**

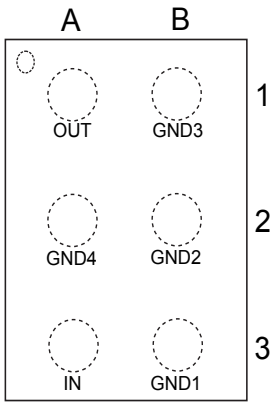



Table 5. **Pad description top view (pads down)**

| Pad ref | Pad name | Description |
|---|---|---|
| A1 | OUT | Antenna |
| A2 | GND4 | Ground |
| A3 | IN | STM32WB5x and STM32WB1x out |
| B1 | GND3 | Ground |
| B2 | GND2 | Ground |
| B3 | GND1 | Ground |

Figure 12. **Tape and reel outline**

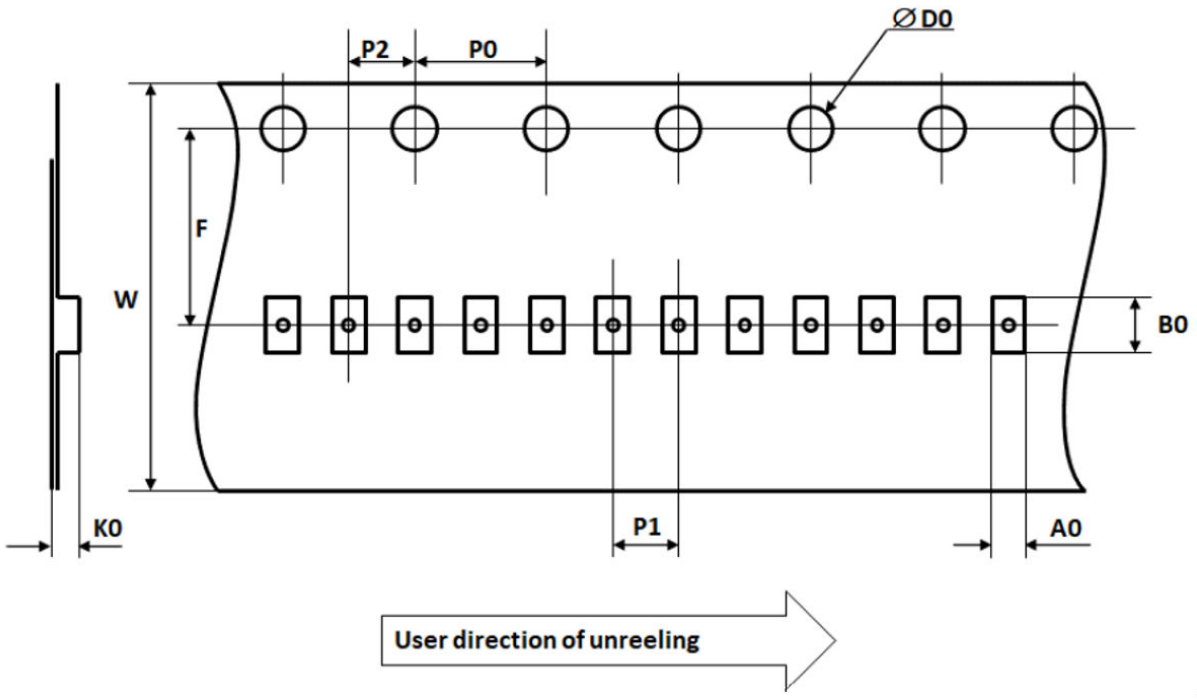


**Table 6. Tape and reel mechanical data**

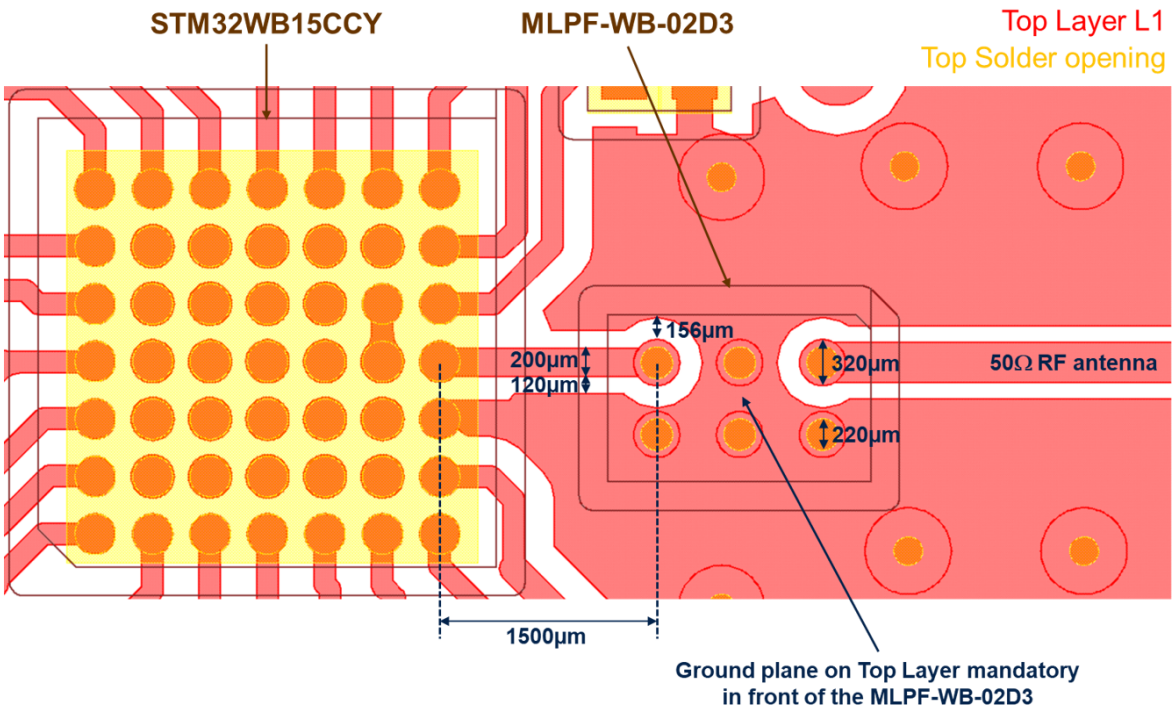
| Ref | Dimensions | | |
|---|---|---|---|
| | Millimeters | | |
| | Min | Typ | Max |
| A0 | 1.06 | 1.09 | 1.12 |
| B0 | 1.66 | 1.69 | 1.72 |
| D0 | 1.40 | 1.50 | 1.60 |
| F | 3.45 | 3.50 | 3.55 |
| K0 | 0.69 | 0.72 | 0.75 |
| P0 | 3.90 | 4.00 | 4.10 |
| P1 | 1.95 | 2.00 | 2.05 |
| P2 | 1.95 | 2.00 | 2.05 |
| W | 7.90 | 8.00 | 8.30 |

# 3 Recommendation on PCB assembly

## 3.1 Land pattern

Layout example using STM32WB15CCY.

**Figure 13. PCB land pattern recommendations**




Transmission line between MLPF and antenna is dimensioned to 50 ohms characteristic impedance.

Transmission line between STM32 and MLPF is dimensioned to 61 ohms characteristic impedance.

These transmission line characteristic impedances have to be followed as closely as possible.

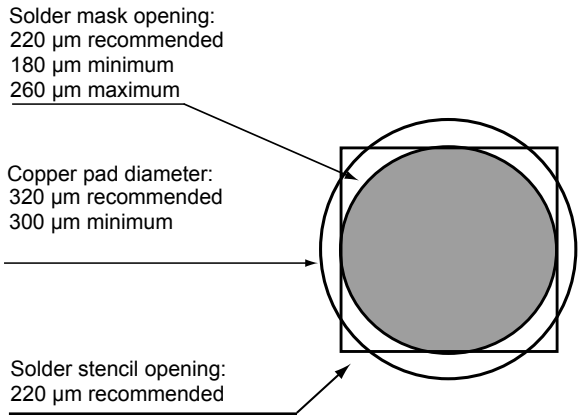
Moreover, the physical dimensions of the lines have to be tuned according to a specific PCB stack-up if it is different from the one presented in the datasheet to maintain the expected characteristic impedance values. In the case of the Figure 13, the transmission lines are designed assuming a ground plane reference on L3.

**Figure 14. PCB stack-up recommendations**

| # | Name | Material | Type | Weight | Thickness | Dk |
|---|---|---|---|---|---|---|
| | Top Overlay | | Overlay | | | |
| | Top Solder | Solder Resist | Solder Mask | | 0.03mm | 3.6 |
| 1 | L1 | | Signal | 1/3oz | 0.012mm | |
| | Dielectric 1 | 1 x 1080 | Prepreg | | 0.065mm | 3.5 |
| 2 | L2 | | Signal | 1/3oz | 0.012mm | |
| | Dielectric 2 | 1 x 2113 | Prepreg | | 0.08mm | 3.6 |
| 3 | L3 | | Signal | 1/2oz | 0.0175mm | |
| | Dielectric 3 | FR4 | Core | | 1.2mm | 4.9 |
| 4 | L4 | | Signal | 1/2oz | 0.0175mm | |
| | Dielectric 4 | 1 x 2113 | Prepreg | | 0.08mm | 3.6 |
| 5 | L5 | | Signal | 1/3oz | 0.012mm | |
| | Dielectric 5 | 1 x 1080 | Prepreg | | 0.065mm | 3.5 |
| 6 | L6 | | Signal | 1/3oz | 0.012mm | |
| | Bottom Solder | Solder Resist | Solder Mask | | 0.03mm | 3.6 |
| | Bottom Overlay | | Overlay | | | |

## 3.2 Stencil opening design

**Figure 15. Footprint - 3 mils stencil - solder mask defined**




## 3.3 Solder paste

1. Halide-free flux qualification ROL0 according to ANSI/J-STD-004.
2. “No clean” solder paste is recommended.
3. Offers a high tack force to resist component movement during high speed.
4. Use solder paste with fine particles: powder particle size 20-38 µm.

## 3.4 Placement

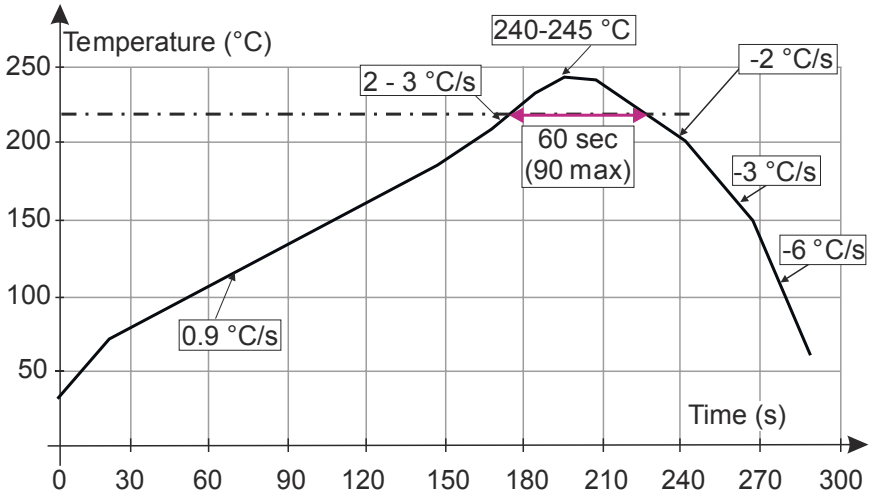
1. Manual positioning is not recommended.
2. It is recommended to use the lead recognition capabilities of the placement system, not the outline centering
3. Standard tolerance of ±0.05 mm is recommended.
4. 1.0 N placement force is recommended. Too much placement force can lead to squeezed out solder paste and cause solder joints to short. Too low placement force can lead to insufficient contact between package and solder paste that could cause open solder joints or badly centered packages.
5. To improve the package placement accuracy, a bottom side optical control should be performed with a high resolution tool.
6. For assembly, a perfect supporting of the PCB (all the more on flexible PCB) is recommended during solder paste printing, pick and place and reflow soldering by using optimized tools.

## 3.5 PCB design preference

1. To control the solder paste amount, the closed via is recommended instead of open vias.
2. The position of tracks and open vias in the solder area should be well balanced. A symmetrical layout is recommended, to avoid any tilt phenomena caused by asymmetrical solder paste due to solder flow away.

## 3.6 Reflow profile

**Figure 16. ST ECOPACK recommended soldering reflow profile for PCB mounting**




*Note: Minimize air convection currents in the reflow oven to avoid component movement.*

*Note: More information is available in the application note:*

- *AN2348 Flip-Chip: "Package description and recommendations for use"*

# 4 Ordering information

Table 7. **Ordering information**

| Order code | Marking | Package | Weight | Base qty. | Delivery mode |
|---|---|---|---|---|---|
| MLPF-WB-02D3 | TX | CSPG | 1.82 mg | 5000 | Tape and reel |

## Revision history

Table 8. **Document revision history**

| Date | Revision | Changes |
|---|---|---|
| 29-Jul-2022 | 1 | Initial release. |
| 25-Nov-2022 | 2 | Updated *Section 3.1: Land pattern*. |
| 25-Sep-2024 | 3 | Updated Section 3.1: Land pattern. |

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